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ABSTRACT

As the need for distance education grows, requirements for the development of high-speed network-based real-time distance learning systems increases. MHEG-5 is the fifth part of the MHEG (Multimedia and Hypermedia information coding Experts Group) standard, and it defines a final-form representation for application interchange. This paper describes the design and implementation of a real-time distance learning system based on MHEG-5 standards. This system contains a session managing module to support multi-user collaboration environments and can provide applications such as video-conferencing and distributed computer-assisted instruction (CAI), as well as non real-time applications such as bulletin board systems and video on demand. It can also support effective student management using the session managing mechanism for real-time user interaction handling. Topics discussed include: system design and implementation, including the MHEG engine, the session managing module, and servers; learning scenarios, including video lecturing and courseware browsing; and plans for future developments. Six figures include the MHEG-5 class hierarchy; the configuration of the system; the session managing module; the MHEG object used by test; the client application from the student side; and the client application from the lecturer side. Contains 14 references. (Author/DLS)

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MHEG based Distance Learning System on Information Superhighway

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Abstract : As need of distance learning grows more and more, requirements for development of high-speed network based real time distance learning system become spread. MHEG-5 is the fifth part of the MHEG standard and it defines a final-form representation for application interchange.
In this paper, we design and implement real-time distance learning system based on MHEG-5 standard. As we design that it contains session managing module to support multi user collaboration environments, it can provide real-time educational application such as videolecturing and distributed CAI. Also it can provide non real-time application such as bulletin board systems, video on demand, etc. And we can support effective student management using session managing mechanism for real-time user interaction handling.

1. Introduction

Distance learning is a new field that can overcome the limitation of previous education criteria[Campbell, Hurley, Jones and Stephens 1995, Dwyer, Barbeiri and Doerr 1995]. So requirements for development of high-speed network based real time distance learning system become spread. But, representing and exchanging educational multimedia contents are too difficult[Lockyer and Badham 1995]. MHEG-5 is the fifth part of the MHEG standard suite[ISO 1997]. The standard defines a final-form representation for application interchange so that the application only has to be developed one time. In this paper, we design real-time distance learning system on information superhighways based on MHEG-5 standard.
As we design the system contains session managing module to support multi user collaboration environments, it can provide real-time educational application such as videoconferencing and distributed CAI. Also it can provide non real-time application such as bulletin board systems, video on demand, etc. We design the MHEG-5 engine using MHEG-5 encoding/decoding class library[Lee and Wang 97a], so it can be easily modified when some modification needed. We can support effective student management using session managing mechanism for real-time user interaction handling.

2. Related Works

MHEG is an ISO/IEC and ITU standard for the interchange representation of multimedia/hypermedia information objects[ISO 1994]. Approved by ISO in 1995, MHEG currently receives very strong interest from most major actor in the interactive TV market, as the standard for set-top-unit high-level API. The developers can implement interoperable multimedia systems and information providers can implement open multimedia applications, using the MHEG standard[Hofrichter and Bitzer 1996, Cossmann et al 1995, Steinmets and Nahstedt 1995]
MHEG-5 is the fifth part of the MHEG standard suite[ISO 1997, Joseph 1995]. It was developed to support the

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distribution of interactive multimedia applications in a client/server architecture across platforms of different types and brands. The standard defines a final-form representation for application interchange so that the application only has to be developed one time. [Fig. 1] shows MHEG-5 class hierarchy.

Figure 1: MHEG-5 class hierarchy

3. System Design & Implementation

In this paper, we use some session-specific mechanisms such as centralized controlling, multicasting, collaborating. We implement this system at 100base-T ethernet and Pentium-pro™ 200MHz Server as hardware environment. We use MS Windows NT™ 4.0 as operating system and MS Visual C++™ 5.0, Win32 SDK, MHEG-5 encoding/decoding class library as development tools.

3.1 Overview

[Fig. 2] shows overall system configuration.

Figure 2: Configuration of system

3.2 MHEG Engine

In client side, MHEG-5 engine contains object managing module and presentation module. Object managing module has encoding/decoding module for MHEG-5 objects. Presentation module has object interpreter and interaction handler. Object managing module fills a role of interpreting and converting between MHEG-5 objects

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and internal objects. In presentation module, object interpreter reorganizes internal objects from object pool, and interaction handler processes link and action operations. We use MHEG-5 engine in [Lee and Wang 1996, Lee and Wang 97a].

3.3 Session Managing Module

In server side, session managing module has group managing module and event handler[Manthe and Mamuye 1996, Rodden and Blair 1992]. [Fig. 3] shows architecture of session managing module.

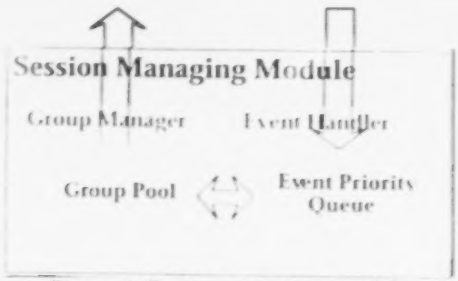

Figure 3: Session managing module

Group managing module operates as gateway. It authenticates and manages participated users. Event handler processes events that occur in each group. Group managing module creates appropriate group for user requirement, and manages those using group pool. Once event occurs, interaction handler catches that. If it cannot be handled, interaction handler sends it to event handler. Event handler processed that using group managing interfaces. Events handled by event handler require group-related operations such as create, destroy, join, and leave.

3.4 Servers

Courseware and BBS server has educational materials. We store courseware as MHEG-5 object representation form using MhegDitor[Leroy and Charbonnel 1997]. Students can browse these materials using MHEG-5 engine and presentation system. It appeared to students as tree-liked form, so students may select any content in a view. If there are some questions about materials, students may use bulletin board system or E-mail. For videolecturing and video on demand, media stream server stores movie files and supplies stream-related service. Using MHEG-5 representation form, movie files can be used during courseware browsing or videolecturing.

4. Learning Senarios

In this chapter, we describe two learning scenarios that can be occurred when students use this system. The first case is using videolecturing feature of our system. The other case is using courseware-browsing feature.
In order to testify the student administration ability in group, we designed the class with one lecturer and four student. And in order to testify functions of real-time application, we used MHED objects for videolecturing. These MHEG objects were made by MhegDitor 1.3 and edited by encoding/decoding class library for MHEG-5 objects[Lee and Wang 97a]. [Fig. 4] represents MHEG objects used by lecturer.

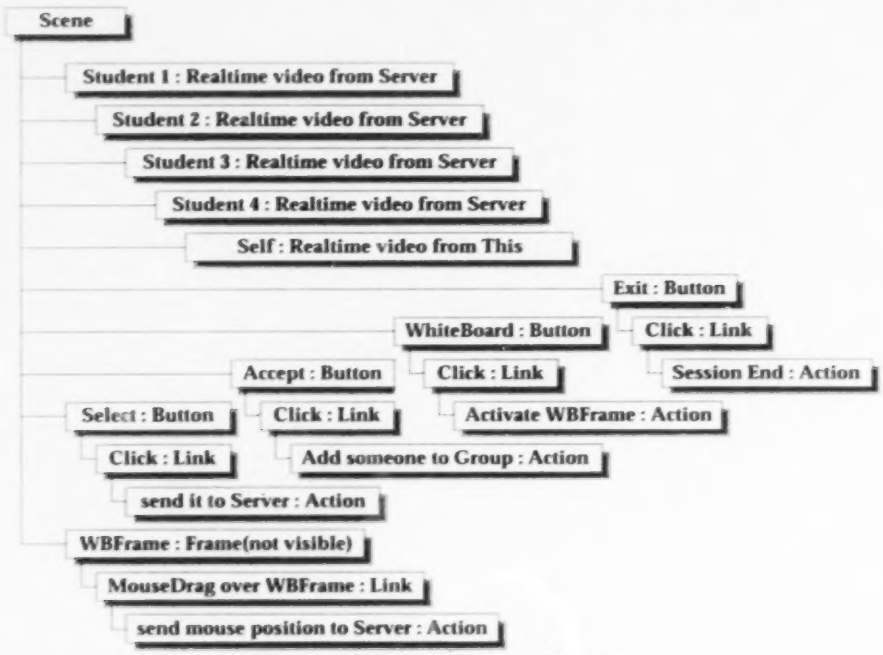
Scene
Student 1 : Realtime video from Server
Student 2 : Realtime video from Server
Student 3 : Realtime video from Server
Student 4 : Realtime video from Server
Self : Realtime video from This
Exit : Button
WhiteBoard : Button
Click : Link
Accept : Button
Click : Link
Session End : Action
Select : Button
Click : Link
Activate WBFrame : Action
Click : Link
Add someone to Group : Action
send it to Server : Action
WBFrame : Frame(not visible)
MouseDrag over WBFrame : Link
send mouse position to Server : Action

Figure 4: MHEG object used by test

4.1 VideoLecturing

A student executes a client application to connect media stream server. Then login dialog appears, and the students inputs username and password. After login process, a session view appears to and the students. Then he/she selects a group that he takes interests in.

When and the students participation succeeds, his/her participation is notified other students and lecturer in that group. Then, and the students can view lecturer's video stream and whiteboard. During videolecturing, lecturer can monitor participated students. Lecturer selects certain student to give token as the right of speech. The student who has that token speaks his/her opinion. After student's speech, lecturer owns that token for next right of speech. Also, a student requires token for his/her own right of speech. When lecturer draws some figures on whiteboard, these figures are shown to all participated students.

4.2 Courseware Browsing

A student executes a client application to connect media stream server. Then login dialog appears, and he/she inputs username and password. After login process, a group view appears to him/her. Then he/she selects a group that he takes interests in. When his/her participation succeeds, his/her participation is notified other students and lecturer in that group. Then, he/she can view lecturer's video stream and whiteboard.

During video lecturing, lecturer can monitor participated students. Lecturer selects certain student to give token as the right of speech. The student who has that token speaks his/her opinion. After student's speech, lecturer owns that token for next right of speech. Also, a student requires token for his/her own right of speech. When lecturer draws some figures on whiteboard, these figures are shown to all participated students. [Fig. 5] shows client application in lecturer side.

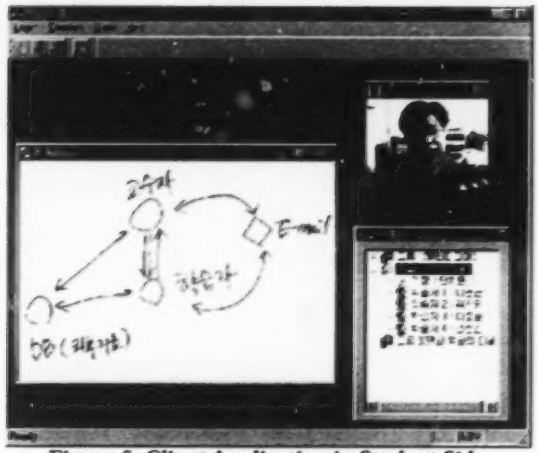

Figure 5: Client Application in Student Side

[Fig. 6] shows the example that lecturer sent additional information to students using whiteboard. These types of Session management facilities are enough to control the participated students. In this experimentation, we show that the designed framework can be used for applications that require efficient group management and control, and it can support to handle user interaction in real time environments.

Figure 6: Client Application in Lecturer Side

In this case, a student also executes a client application to connect courseware and BBS server. Then login dialog appears, and he/she inputs username and password. After login process, a courseware view appears to him/her. Courseware view is represented by tree-liked form. Then he/she selects a topic that he takes interests in. Selected topic is provided as MHEG-5 application object. That has several or a number of scenes that compose of various multimedia presentations. Browsing courseware is same as hypermedia navigation. Students may have some questions about courseware when browsing. Then they can use both bulletin board system and E-mail. When a question registered, lecturer would read and reply answer to student for that question.

5. Conclusion & Future Works

Implemented system has several advantages. It can provide effective presentation and management for multimedia

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information using MHEG standard. And we can use its user management facilities for real-time multimedia applications that should support real-time user interaction. Also encoding/decoding class library applies to various MHEG-5 based applications.

There is an important feature to enhance educational values of this system. Currently, we cannot provide student-evaluating facilities. We plan to implement integrated distance learning system that contains intelligent tutoring features[Lee and Wang 97b].

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